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**ENERGY MANAGEMENT  
AND  
IMPLEMENTATION PLAN**

**Oak Ridge  
National Laboratory**

**FY 2004**

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# FY 2004 ORNL ENERGY MANAGEMENT and IMPLEMENTATION PLAN

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## Acronyms and Abbreviations

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Btu	British thermal unit
CEM	Certified Energy Manager
CFC	Chlorofluorocarbons
DDC	Direct digital control
DOE	Department of Energy
EPA	Environmental Protection Agency
ESCO	Energy service company
ESPC	Energy savings performance contract
FEDS	Facility Energy Decision System
FEMP	DOE - Federal Energy Management Program
FTE	Full time employee
FY	Fiscal Year
GSA	General Services Administration
GSF	Gross square feet
HVAC	Heating, ventilation, and air conditioning (system)
IHEM	In-House Energy Management
LEED™	Leadership in Energy & Environmental Design
MW	Megawatt
MWh	Megawatt hours
NIST	National Institute of Standards and Technology
ORNL	Oak Ridge National Laboratory
PADS	Performance and Development System
TVA	Tennessee Valley Authority
UESC	Utility energy services contract
USGBC	U.S. Green Building Council

## Executive Summary

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The purpose of this plan is to outline the strategy for managing and implementing short-range and long-range energy and energy-related activities at the Oak Ridge National Laboratory (ORNL). This Energy Management and Implementation Plan reflects progress made towards and strategies for accomplishing the goals and requirements established by the Energy Policy Act, October 24, 1992; U.S. Department of Energy (DOE) Order 430.2A, "Departmental Energy and Utilities Management", April 15, 2002; and Executive Order 13123, "Greening the Government Through Efficient Energy Management", June 3, 1999. As a result of the emphasis that ORNL has placed on energy and utilities management, and as a result of the implementation of DOE In-House Energy Management (IHEM) projects at ORNL, building energy intensity has been reduced by 19.7 percent compared to FY 1985 (based on Btus per gross square foot). Since the EO 13123 goal for federal agencies is to meet or exceed a 30-percent reduction by FY 2005, this performance indicates that ORNL has contributed a significant share towards DOE's success. Although there are no official goals for metered process (exempt) facilities, energy intensity has been reduced by 65 percent in those facilities compared to FY 1985.

Other related areas, which support both short-range and long-range goals and in which ORNL is actively participating, are the following: maintaining a well-trained energy management staff, recognizing and rewarding outstanding performance by employees, completing energy audits and projects through energy savings performance contracting, purchasing Energy Star® and other energy-efficient products, identifying Energy Star® buildings, incorporating sustainable building design, making industrial facility efficiency improvements, improving on water conservation, acquiring "green power", and replacing chillers that have CFCs. Although ORNL is working to support the goals of EO 13123, as well as the DOE Energy Efficiency Leadership Goals listed in Appendix B, specific FY 2003 performance measures that were negotiated with DOE – Oak Ridge Operations and their results are listed in Appendix A.

## Background

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### ***ORNL Facilities***

The Oak Ridge National Laboratory is a multiprogram science and technology laboratory managed for the U.S. Department of Energy by UT-Battelle, LLC. In support of the Department's missions, ORNL conducts basic and applied research and development to create scientific knowledge and technological solutions that strengthen the nation's leadership in key areas of science; increase the availability of clean, abundant energy; restore and protect the environment; and contribute to national security.

ORNL was established in 1943 as part of the secret Manhattan Project – the World War II race to develop the atomic bomb – and is located 20 miles west of Knoxville, Tennessee. It is the largest of the U.S. Department of Energy's five multiprogram energy laboratories. The current annual budget is over \$1 billion and ORNL is staffed with approximately 3,800 employees and hosts approximately 3,000 visiting researchers annually. Major programs at ORNL involve energy conservation, materials development, magnetic fusion energy, nuclear safety, robotics and computing, biomedical and environmental sciences, medical radioisotope development, and basic chemistry and physics.

ORNL has maintained a successful Energy Management program for several years. The ORNL Energy Manager and support personnel have worked directly with the Oak Ridge Operations Office and the Federal Energy Management Program (FEMP) in Washington, DC, to identify, design, and implement energy and energy-cost savings projects. These projects have helped contribute to an approximate 20 percent overall, non-process building energy reduction per gross square foot at the site as compared to FY 1985 and an approximate 65 percent overall, process-building energy reduction since FY 1985.

A few years ago federal budget actions by Congress eliminated the IHEM Program Office and its project-funding stream for DOE sites, although some limited funding has since been made available through FEMP. This lack of large-scale funding presents a significant challenge as ORNL attempts to comply with the energy reduction requirements in the DOE and Executive Orders. This Energy Management and Implementation Plan will provide ORNL's approach to accomplishing the specific energy conservation requirements in light of the current budget restrictions.

ORNL has developed a comprehensive strategy for supporting the energy-related requirements of Executive Order 13123 and related energy orders. This strategy incorporates three major areas: employing energy efficiency in new building construction, employing energy and utilities conservation policies and practices across the site, and fully employing Energy Savings Performance Contracting (ESPC) as a vehicle to fund, develop, and implement additional energy conservation projects.

## ***ORNL Progress toward Energy Reduction Goals***

At ORNL the energy consumption in Btu per gross square foot (GSF) for standard buildings has been reduced by approximately 20 percent as compared to the FY 1985 baseline year. This is in support of the Executive Order 13123 goal for agencies such as DOE to reduce building energy use by 30 percent by FY 2005 compared to the FY 1985 baseline. Although there are no official goals for metered process (exempt) facilities, energy intensity has been reduced by 65 percent in those facilities compared to FY 1985.

To help ensure that ORNL continues to make even greater progress in energy intensity reductions, ORNL negotiated with DOE-ORO to establish a Performance Measure in the Buildings/Facilities category (reference Appendix A). In order to meet expectations for this short-range goal in FY 2003, ORNL had to reduce energy intensity (Btus per gross square foot) by at least 2.1% during a group of selected months. Unfortunately, however, performance on this measure was less than expected. The winter months in FY 2003 were 16.6% colder than the same months in FY 2002, based on Heating Degree Days. This caused a greater demand for electric and steam heat, driving up the Btus per square foot. Also, increased research activities in buildings that have labs as well as offices caused increases in energy usage for several buildings. Finally, increased construction activities and the startup and testing of completed facilities, as well as the relocation of staff from off-site to on-site, caused increases in utility loads. ORNL did, however, finish FY 2003 in good order during the final three months, resulting in an overall reduction in building energy intensity for the FY as a whole. This success at the end of FY 2003 is expected to be continued during FY 2004.

Currently, ORNL does not have any facilities in the Industrial, Laboratory, Research, and Other Energy-Intensity Facilities category. The baseline year for energy reductions in those facilities, if

ORNL had such classifications, would be FY 1990 with a goal of a 20 percent reduction by FY 2005.

In addition to the Spallation Neutron Source facility, nine additional ORNL facilities are exempt from EO 13123 performance goals due to their high demand for energy to support research and/or process activities.

Figure 1.0 below depicts ORNL progress in helping DOE to meet the Energy Policy Act of 1992 and Executive Order 13123 goals. ORNL has made significant strides in energy reductions per square foot since the FY 1985 baseline year and even over the past several years. These are due in large part to the many IHEM projects implemented, older chillers being replaced, and enhancements at the central steam plant.

However, the years ahead are faced with significant challenge as can be seen from the figure. In order to continue progress, additional energy projects are being pursued through energy savings performance contracting, and, as a result of the Facility Revitalization Project, older inefficient buildings are being shutdown and new, more efficient buildings are being designed and constructed.

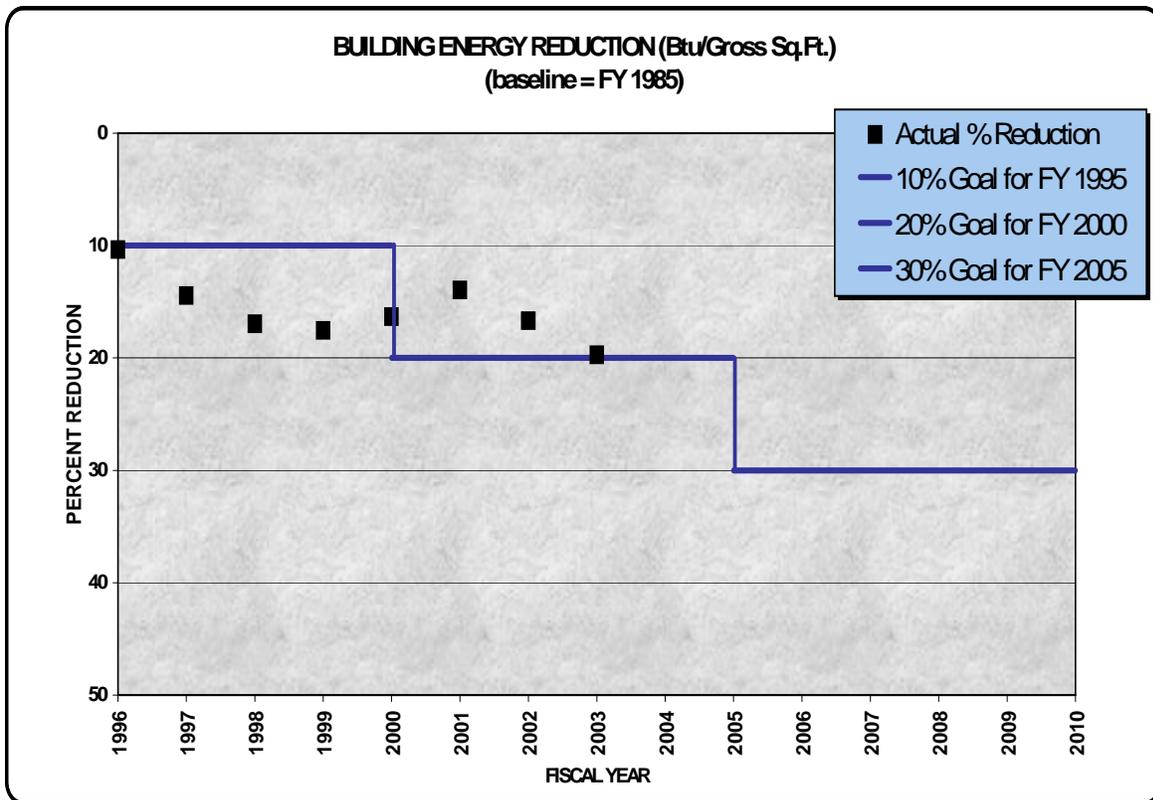


Figure 1.0 – Actual Building Energy Reduction in Btus per Gross Square Foot by Fiscal Year, Compared to the FY 1985 Baseline and EPACT 92 and Executive Order 13123 Goals.

## **Implementation Plan**

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### ***Energy Management Infrastructure***

#### **The ORNL Energy Manager**

ORNL Energy Manager is the engineer responsible for advocating policy, programs, and initiatives to implement Executive Order 13123 at ORNL. Activities through this position provide a key role in increasing site efficiency, maintaining past energy conservation gains, and pursuing DOE and ORNL energy and energy-related initiatives.

#### **The ORNL Energy Management Staff**

The energy management staff at ORNL consists of six engineers, four of which are licensed Professional Engineers and five of which are Certified Energy Managers through the Association of Energy Engineers national certification program. Additionally, two engineers are LEED™ (Leadership in Energy & Environmental Design) Accredited Professionals through the USGBC national accreditation program. Of the six-person energy management staff at ORNL, approximately 1.5 FTEs directly support the energy management program at ORNL while the remainder of the staff directly supports DOE's Federal Energy Management Program and other related activities.

## **Management Tools**

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#### **Awards**

Although there is no specific employee recognition program for supporting Executive Order 13123, ORNL does utilize an in-depth, general Honors and Awards Program, a Director's Award for accomplishment in laboratory operations and technical support, and a Values award program to recognize employees in all areas of achievement. The Honors and Awards Program recognizes those employees who have provided outstanding service in several areas, some of which are in the category of laboratory operations support. Honorees attend an Awards Night ceremony and dinner and receive further recognition through internal ORNL web pages.

The Director's Award is given to those individuals or teams that have demonstrated excellence above their normal job duties in operations and support areas and other areas. These awards are announced at an Awards Night ceremony and dinner and receive further recognition through internal ORNL web pages.

The Values awards are for the recognition of those employees or teams who demonstrate high value in concern for people, working together, and in meeting challenging goals. The awardees are honored at a recognition program.

## Performance Evaluations

In general, ORNL has successfully implemented the Performance and Development System (PADS) in order to better evaluate employee performance and ensure personal development. All employees are required to develop a PADS Results Plan with performance-based objectives for their area of responsibility. Each employee's supervisor approves this Results Plan and the plan's objectives are implemented throughout the performance year. Near the end of the year, the employee, their supervisor, and any customers or peers that have been nominated to also provide input perform an assessment of the employee's performance as compared to their Results Plan. The assessments are used to by management to determine performance-based salary allocations.

Evaluation of the ORNL Energy Manager is based on performance criteria measuring support to DOE's energy management program, ORNL's utility allocation program, and ORNL's energy management program.

## Training and Education

Each year technical personnel at ORNL plan short-range training that has long-range benefits. This past year 10 engineers attended energy management training during three days of technical sessions at the "Energy 2003" conference and two engineers attended the "Laboratories of the 21st Century" workshop. Also, four engineers attended the World Energy and Engineering Conference and technical sessions. Although no one attended a one-day workshop on LEED™ (Leadership in Energy & Environmental Design) requirements in FY 2003, additional LEED™ training is planned for FY 2004. (LEED™ is further discussed in the "Sustainable Building Design" section of this document.) Twenty-five utilities staff attended a one-day Boiler Water Seminar to review boiler and steam system operational efficiency. Four engineers attended a three-day training seminar on Building Commissioning. Six electrical and mechanical staff attended a two and one-half day session on operating and maintaining energy-efficient HVAC equipment and systems. Finally, 20 electrical staff attended a two-day session on direct digital controls systems.

In order to raise each employee's energy conservation and pollution prevention awareness, a display of energy conservation materials was established at the ORNL cafeteria during October, Energy Awareness Month. The display included an assortment of energy-related materials: posters, key tags, vinyl window decals, energy "post-it" note pads, bookmarks, thermostats, and magnets. The event was announced on *ORNL Today*, the internal news website for all staff. Also, an article in *ORNL Today* issued a reminder for everyone to turn off their space lighting and computer systems when they are not needed.

## Showcase Facilities

No additional facilities were identified as a Showcase Facility during the past year. One, new ORNL facility currently being constructed will be designated as a Showcase Facility, if appropriate.

## **Implementation Strategies**

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### **Life-Cycle Cost Analysis**

The ORNL Master Design Criteria's Section 12 (Energy and Sustainability) requires that buildings/systems meet 10 CFR 434, 10 CFR 436, Executive Order 13123, and other applicable codes and standards for energy conservation and design. Also, Standard Operating Procedure SOP-ENG-PM21 (Project Execution Plan) requires that life-cycle cost and energy conservation assessments be completed, and SOP-ENG-PM31 (Project Reviews and Reporting) invokes energy conservation and life-cycle cost analysis assessments. Finally, SOP-ENG-D.03 (Design Analysis and Calculations) lists the required energy conservation, energy usage, and life-cycle cost calculations that are required for projects. Design tools and guides available include the NIST Building Life-Cycle Cost Computer Program, ORNL-ENG-G01 (Project Management System Manual), ORNL-ENG-G15 (Sustainable Design Process), and others. EPA Energy Star®, USGBC LEED™, and LCCA requirements were successfully incorporated into design criteria for ORNL's newest facilities.

As always, one of the challenges in the design and procurement of energy efficient products, systems, and equipment is balancing the first cost of the item with the lifetime energy savings. This is especially true for equipment procurements. Items with the lowest first cost tend to have a low energy efficiency, while items with the highest energy efficiency tend to have the highest first cost.

As an example on how this balance can be achieved, in implementing the past ORNL water chiller replacement plan to eliminate CFCs, ORNL used an integrated systems approach that provided the "best value" to the Government with regard to first cost, lifetime cost, and CFC elimination. Bidders were invited to submit for review a series of chillers with varying degrees of first cost and energy efficiency. An evaluated-bid procurement process was then used to select the most energy efficient chiller possible, but only if the incremental, additional first cost, or price premium (when compared to the next less-efficient chiller), could be economically justified by the incremental, additional energy cost savings. In that way, a balance of first cost with lifetime energy cost was achieved, and ORNL was able to replace a significant number of CFC chillers with non-CFC chillers that had both a reasonable first cost and a reasonable efficiency.

Similar, large-scale procurements will give due consideration to life-cycle cost aspects.

### **Facility Energy Audits**

Initially, ORNL audited approximately 200 buildings totaling some 3,000,000 square feet, or about 87 percent of the floor space. The buildings were categorized into high, medium, and low energy use facilities; central research facilities; generic office buildings; trailers; and, energy-intensive buildings. The technical aspects of the audits then focused on the energy requirements of the HVAC systems, motors, pumps, and fans. Specific, potential energy conservation opportunities were identified for each of the building categories.

To complete the comprehensive audit effort at ORNL two activities were performed: (1) a site-wide energy savings performance contract (ESPC) evaluation and (2) the Facility Revitalization Project. For the first activity, ORNL used an energy service company (ESCO) that is contracted

under DOE's southeast-region ESPC. A revised proposal has been received from the ESCO, and it is currently being evaluated. Those energy projects that are life-cycle cost effective and can be accomplished through an ESPC – or by any method – will be implemented.

Secondly, the Facility Revitalization Project's purpose is to develop both short-term and long-term plans for the disposition of ORNL facilities. Options include renovating existing facilities, vacating old inefficient facilities, and building new facilities. The auditing and assessment of older facilities is critical in phasing out and disposing of inefficient facilities. In FY 2002 the shutdown of inefficient facilities reduced energy costs by over \$330k per year. In FY 2003 continued shutdown of facilities resulted in additional energy cost savings of \$71k per year. Similar savings are actively being pursued in FY 2004.

Both of these current activities, along with past audits, effectively complete comprehensive facility energy auditing assessments at ORNL.

## **Financing Mechanisms**

ORNL did not award any new energy savings performance contracts or any utility energy services contracts (UESCs) during FY 2003, however the previous ESPC delivery order that was completed in early FY 2002 and was valued at approximately \$291K is saving an estimated \$760K over the term of the project. As mentioned above, a revised proposal has been received from the ESCO for a second ESPC and is being evaluated. Comments have been received from ORNL staff and from DOE-HQ. Those energy projects that are life-cycle cost effective and can be accomplished through an ESPC – or by any method – will be implemented. If completed, this new ESPC delivery order would be valued at approximately \$6M with an annual savings of \$500K. Finally, the possible use of UESCs is currently being investigated; a UESC may be pursued for funding, designing, and implementing needed electrical power system upgrades at ORNL.

## **Energy Star® and Other Energy-Efficient Products**

As stated previously, the ORNL Master Design Criteria's Section 12 (Energy and Sustainability) requires that buildings/systems meet 10 CFR 434, 10 CFR 436, Executive Order 13123, and other applicable codes and standards for energy conservation and design. Also, Standard Operating Procedures and Guides ensure that appropriate energy conservation, life cycle cost, and sustainable design aspects are being addressed and incorporated into specifications and design criteria for new buildings and renovations.

In order to demonstrate the use of energy-efficient products, in FY 2002 ORNL installed six LED-type traffic signals at an intersection instead of the more common, incandescent bulb signals. These new signals are continuing in service. A picture of the installation and an article explaining the energy, environmental, and maintenance benefits of the new signals was published on the internal *ORNL Today* weekly news web page at the time of the installation.

## **Energy Star® Buildings**

In FY 2000 an assessment of the energy efficiency of buildings at ORNL led to one building being officially designated as an Environmental Protection Agency (EPA) Energy Star® building. Performance documentation related to the Buildings Technology Center headquarters building was submitted to EPA and the certification and label were subsequently awarded. This was one

of the first DOE buildings to achieve this rating and was only the second building in the State of Tennessee to do so.

For the additional buildings that were assessed but did not qualify out-right, the study outlined the energy savings projects that would need to be completed to allow qualification. In part, the assessment identified the need for electrical metering at the buildings. Subsequently as follow-up project, SAVEnergy funding was obtained in FY 2002 and used to install electric meters on several candidate buildings to assist in determining if they also qualify for the Energy Star® award. Currently, metered data is being recorded and will be evaluated in FY 2004. If it can be determined that one or more of the buildings qualify, documentation will be prepared and submitted to the EPA for award of the Energy Star® label(s).

## **Sustainable Building Design**

ORNL is implementing major decisions formed in the Facility Revitalization Project. This project developed both short-term and long-term plans for the disposition of ORNL facilities. As mentioned earlier, options included renovating existing facilities, vacating old inefficient facilities, and building new facilities. Sustainable building design principles are being incorporated into the siting, design, and construction of new facilities. With regard to the siting of new buildings, care is being taken to give priority to the use of brown-field space rather than green-field space. Also, sustainable criteria, including LEED™ requirements, are being used in specifications and design criteria for the new facilities. The LEED Green Building Rating System™ is a priority program of the U.S. Green Building Council. It is a rating system that is based on existing proven technology, and it evaluates environmental performance from a "whole building" perspective over a building's life cycle, providing a definitive standard for what constitutes a "green building". LEED™ is based on accepted energy and environmental principles and strikes a balance between known effective practices and emerging concepts.

In general, the investments being made will support the continued construction of 14 major facilities and the renovation of several others over the next few years. When construction and renovation are completed in 2006, ORNL will have replaced 1.8 million square feet of aging and outdated space with about 600,000 square feet of modern, energy-efficient buildings.

## **Energy Efficiency in Lease Provisions**

The authorization to lease is by DOE, and GSA leasing requirements are invoked. Provisions that can be applied include making an award on the basis of "best value" to the Government (rather than lowest initial cost). Also, the award can be based on a life cycle cost analysis, which would include operational costs – or allowance for the omission of operational costs – and the escalation of operational costs, as appropriate. Finally, the award can include a provision encouraging all offerors to contact a qualified energy service company and have them develop an Energy Savings Performance Contract proposal to determine whether opportunities for cost-effective energy improvements to the space are justified.

As part of the Facility Revitalization Project mentioned earlier, new facilities are being developed, constructed, and leased. Project management investigated how to best incorporate energy efficient criteria into the project. One method that was implemented was to require the new building(s) to be LEED™-certified where appropriate. Requiring a new building developer to provide a LEED™-certified building will help incorporate many energy efficient, pollution prevention, and sustainable aspects into the design. Additionally, specifications for the new

buildings require that the design lead to a completed building that could receive an EPA Energy Star® label award for the office areas.

## **Industrial Facility Efficiency Improvements**

In FY 2003 ORNL continued with the implementation of a 10-year master plan for the central Steam Plant. As a result of this plan, the steam plant has converted from coal to natural gas as the primary fuel. This conversion has allowed the burning of coal and the handling of coal to be eliminated and will save significant energy, maintenance, operation, and environmental-related expenses in future years. As part of this effort, two coal-fired boilers were modified so that they could burn natural gas more efficiently. Additionally, the former coal yard's top surface was stripped off so that it could be leveled and reclaimed, primarily as a storage area. Finally, boiler control improvements that began in FY2002 were completed in FY 2003. Other improvements are being planned.

A major heating, ventilating, and air-conditioning (HVAC) line-item project to improve the central chilled water plant entered the detailed design phase in FY 2001, continued in FY 2002, and construction was completed in FY 2003. To improve the energy efficiency of the system, a primary/secondary pumping arrangement was installed. Also, as part of this project, three old air-handling units were replaced as were hot water reheat coils and systems in a major research facility.

In FY 2003 ORNL continued with the initial phase of a survey and audit of the primary direct digital control (DDC) system. The final phase of this assessment will be completed in FY 2004 and, as a minimum, all low-cost/no-cost repairs and improvements will be pursued. Finally, detailed engineering studies that will assess central chiller plant controls, reliability, and system upgrades are planned for FY 2004.

## **Highly Efficient Systems**

The highly efficient systems category is currently not applicable at ORNL.

## **Off-Grid Generation**

ORNL does not have any large-scale off-grid generation capability. However, in FY 2001 a natural gas-fired micro turbine was installed by the ORNL Engineering, Science, and Technology Division, and it continues in service. The turbine is tied into the TVA electrical power grid and can generate 30 kilowatts of power. The turbine can be remotely monitored, started, and stopped. Although it is tied into the electrical power grid, the turbine is primarily being used for research in the area of enhancing energy efficiency components and systems. The turbine has also been incorporated into ORNL's photovoltaic distributed energy resource project, which was designated a Federal Energy Saver Showcase Award Winner in FY 2002 by DOE-FEMP.

## **Water Conservation**

The contract governing treated/potable water for ORNL was renegotiated and restructured in FY 2000. Pursuant to the contract, the water, which originates from the City of Oak Ridge Water Treatment Plant, is being supplied to ORNL at a lower cost. ORNL is still committed to reducing water consumption, however. A continuing site-wide program to improve water treatment has significantly reduced the water used for cooling tower blowdown operations.

In FY 2002, in order to identify additional water conservation improvements (and related improvements) that need to be made, a Facility Environmental Vulnerability Assessment Recommendation Implementation (FEVARI) effort was pursued, and the elimination of once-through water-cooling systems was a high priority. That study was essentially completed in FY 2003. As a result of the data collected and assessed, water system projects are being planned for FY 2005 and subsequent years. These projects would not only provide infrastructure improvements, but also would provide some savings in sewage treatment costs and significant savings in process waste treatment costs.

Also, as planned by the Facilities Revitalization Project, two new facilities totaling 267,000 square feet have been completed and other new buildings are being constructed. These facilities incorporate numerous energy-efficient systems and features, and ORNL staff are being moved out of inefficient space and into the new facilities as quickly as possible. These personnel moves have allowed ORNL to reduce both water supply needs and sewage treatment requirements.

In FY 2000, the baseline year for water consumption, ORNL used 1,128.7 million gallons. In FY 2003 the total was reduced to 1,020.4 million gallons. This is a reduction of 108.3 million gallons, or 9.6 percent.

### **Acquisition of Green Power**

In FY 2000 ORNL, in signing up to the Tennessee Valley Authority (TVA) “Green Power Switch” program, became the TVA’s first industrial green power participant. The TVA program presently includes three wind turbines atop Buffalo Mountain in the Southeast’s first commercial-scale use of wind power to generate electricity. Also, the TVA program includes four solar collectors at one site, with eight more sites and a landfill gas-to-energy facility planned in the near future. More specifically, in support of the Green Power Switch program, ORNL signed up for 675 MWh annually at an incremental cost of \$18,000 annually. ORNL is continuing to participate in FY 2004 in the green power program with the same level of support.

### **Reduction of Ozone-Depleting Substances**

As part of an aggressive chiller replacement program, ORNL continues to retire or replace CFC chillers with high-efficiency, non-CFC chillers. To date, 16 chillers totaling 8,200 tons in cooling capacity have been replaced. As a result, chiller energy use has dropped an average of 21 percent for an annual savings of \$280,000 and CFC emissions have been cut by 5000 lbs. per year, saving another \$76,000 annually. Additionally, the chiller replacement program has effected an electrical demand reduction of approximately 1 MW. ORNL is continuing to replace small CFC chillers and has sold all R-113 and most of the R-11 stored refrigerant to a refrigerant-recycler. ORNL will complete the replacement of CFC chillers well ahead of long-range, legislated requirements.

### **Energy-Efficient Operation and Maintenance of Buildings**

Energy management control systems have been installed in 13 buildings, including the installation of 19 variable-speed drives on large supply and exhaust fan motors. Each of these DDC projects have required that the affected HVAC systems be re-commissioned through functional and performance acceptance testing and that components that perform poorly, such as sticking valves and dampers, be either reconditioned or replaced. Preventative maintenance is

performed on energy-using systems and performance is tracked by Operations Managers and Facility Engineers. Additionally, the ORNL Energy Manager tracks energy consumption and utility costs for analysis and reporting purposes.

As part of a DOE Model Program, in FY 2004 ORNL is conducting the retro-commissioning of an older 275,000 square foot laboratory and office building, Building 4500S, in order ensure that utility savings are maximized. The retro-commissioning activities are addressing energy efficiency for heating, ventilating and air conditioning (HVAC) and control systems operation. In addition to the building-specific retro-commissioning improvements that are being identified, the purpose of this project will also be to develop and publish a “model” that other DOE sites can utilize in order to complete similar activities. Additional similar funding has been requested for FY 2004 – 2005.

### **Increase Vehicle Fleet Efficiency and Use of Alternative Fuels**

ORNL is working to minimize the use of petroleum-based fuels in the vehicle fleet. To minimize gasoline consumption, 61 ethanol-burning vehicles have been purchased to-date (12 in FY 2003) and put into service. Where it is practical, cost-effective, and as funding permits, the usage of petroleum-based fuels will be minimized. Additional alternative fuel vehicles will be procured and transitioned into the fleet as funding allows. Although ORNL was not able to reduce the inventory of standard gasoline vehicles in FY 2003, several reductions are planned for FY 2004.

### **Utility Cost Allocation Program**

ORNL uses a computer-based utility allocation program to ensure that monthly utility costs are charged to ORNL customers as fairly and as accurately as possible without overly complicating the process. Beginning with FY 2004, the process was modified, as follows. Major users of utilities are charged directly for that usage, either according to a metered amount where meters are installed or according to a computer program’s calculated amount if not metered. In general, after the direct utility costs are assessed, the remaining utility costs – those for the more typical users – are merged into a common account and charged out at a given rate, either a cost per square foot or a cost per person, whichever is appropriate for each type of utility.

### **Emergency Conservation**

ORNL uses primarily uses electricity, natural gas, and fuel oil as energy and fuel sources. There are several systems in place for employee notification to address high electrical or steam demand situations. The main systems are central staff E-mail notification and laboratory-wide public address announcements.

As for electricity, ORNL’s broad-based “Plan of Action for Emergency Electricity Reductions” outlines a schedule for five stages of load-shedding, identifying specific electrical feeders and circuits to be affected should action become necessary. The ORNL Emergency Electrical Load Shedding Schedule cites approximate percentages that would be achieved if loads were shed for the five stages of alert. For Stage 1 load shedding, an approximate 10% reduction is predicted. The plan lists other steps that can also effect a 10% reduction for a Stage 1 alert. For alert Stages 2 through 5, the emergency load shedding plan estimates that additional electrical demand reductions would be 3MW, 4MW, 4MW, and 4MW, respectively.

With respect to natural gas and fuel oil, which are used to make steam, ORNL has drafted an “Emergency Steam Load Shedding Plan” for the central Steam Plant. Should a site-wide power outage occur during a period of high steam demand, or if a severe natural gas or fuel oil curtailment occurred, the Steam Plant would need to enact an immediate load-shedding plan in order to ensure that plant operations could continue. The draft plan identifies steam headers and branches that can be isolated and approximate steam loads in those lines and in buildings that use steam. Also, the draft plan provides for the shutdown of main supply and exhaust fans since, in winter, a large portion of the steam load is due to the tempering and heating of large volumes of outside air. This draft plan is to be further developed as a short-range goal for FY 2005.

## Appendix A

### ***FY 2004 Energy Management Performance Measures and Results for FY 2003***

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#### **Performance Objective:**

The utilization and conservation of energy is effectively managed commensurate with the site mission(s) in accordance with DOE Orders and regulations.

#### **FY 2004 Performance Measures (negotiated with DOE - Oak Ridge Operations) and FY 2003 Results:**

1. Percentage of annual reduction in site energy (excluding metered process buildings) in Btu/Sq.Ft. as compared to the previous four quarters.

FY 2003 Results – For this performance measure, ORNL did not adequately reduce site energy per square foot during the months evaluated for this measure, resulting in the measure **needing improvement**. There were several contributing factors. The winter months in FY 2003 were 16.6% colder than the same months in FY 2002. This caused a greater demand for heat, driving up the Btus per square foot. Also, increased research activities in buildings that have labs as well as offices caused increases in energy usage for several buildings. Finally, increased construction activities and the startup and testing of completed facilities, as well as the relocation of staff from off-site to on-site, caused increases in utility loads. ORNL did, however, finish FY 2003 in good order during the final three months, resulting in an overall reduction in building energy intensity for the FY as a whole. This success at the end of FY 2003 is expected to be continued during FY 2004.

2. Achieve significant progress on the current site-wide energy savings performance contract (ESPC) Initial Proposal.

FY 2003 Results – ORNL facilitated project activities such that the energy service company that submitted the Initial Proposal, in FY 2003, completed the Detailed Energy Survey and also issued a Revised Proposal, **exceeding expectations**. If the Revised Proposal had not been issued, the measure would not have exceeded expectations, and if the Detailed Energy Survey had not been completed, the measure would not have met expectations.

3. Timely updating of the ORNL Energy Management and Implementation Plan to bring it up to date with DOE's most current energy management plans and Orders.

FY 2003 Results – The ORNL Energy Management and Implementation Plan was issued to DOE on February 5, 2003, **exceeding expectations**. If the Plan had been issued after February 28, 2002, the measure would not have exceeded expectations and, if after May 31, 2002, would not have met expectations.

## **Appendix B**

### ***DOE's Energy Efficiency Leadership Goals for FY 2005 and FY 2010***

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#### **Improving Energy Usage**

1. Reduce energy consumption through life-cycle cost effective measures by:
  - 40% by 2005 and 45% by 2010 per gross square foot for buildings, using a 1985 baseline
  - 20% by 2005 and 30% by 2010 per gross square foot, or per other unit as applicable, for laboratory and industrial facilities, using a 1990 baseline.
2. Increase the purchase of electricity from clean energy sources:
  - Increase the purchase of electricity from renewable energy sources by including provisions for such purchase as a component of our request for bids in 100% of all future DOE competitive solicitations for electricity.
  - Increase the purchase of electricity from less greenhouse gas-intensive sources, including but not limited to new advanced technology fossil energy systems and other highly efficient generating technologies.

#### **Reducing Ozone Depleting Substances and Greenhouse Gases**

1. Retrofit or replace 100% of chillers greater than 150 tons of cooling capacity and manufactured before 1984 that use Class I refrigerants by 2005.
2. Eliminate use of Class I ozone depleting substances by 2010, to the extent economically practicable, and to the extent that safe alternative chemicals are available for DOE Class I applications.
3. Reduce greenhouse gas emissions attributed to facility energy use through life-cycle cost-effective measures by 25% by 2005 and 30% by 2010, using 1990 as a baseline.

#### **Increasing Vehicle Fleet Efficiency and Use of Alternative Fuels**

1. Reduce our entire fleet's annual petroleum consumption by at least 20% by 2005 in comparison to 1999, including improving the fuel economy of new light duty vehicle acquisitions, and by other means.
2. Acquire each year at least 75% of light duty vehicles as alternative fuel vehicles, in accordance with the requirements of the Energy Policy Act of 1992.
3. Increase the usage rate of alternative fuel in Departmental alternative fuel vehicles to 75% by 2005 and 90% by 2010 in areas where alternative fuel infrastructure is available.